Complete Summary

GUIDELINE TITLE

Shortness of breath--suspected cardiac origin.

BIBLIOGRAPHIC SOURCE(S)

Schoepf UJ, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Stanford W, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Shortness of breath -- suspected cardiac origin. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 5 p. [34 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Boxt LM, Bettmann MA, Gomes AS, Grollman J, Henkin RE, Higgins CB, Kelley MJ, Needleman L, Pagan-Marin H, Polak JF, Stanford W, Wexler L. Shortness of breath--suspected cardiac origin. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):23-7.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Shortness of breath, suspected cardiac origin

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Cardiology
Emergency Medicine
Family Practice
Internal Medicine
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for patients with shortness of breath, suspected cardiac origin

TARGET POPULATION

Patients with shortness of breath, suspected cardiac origin

INTERVENTIONS AND PRACTICES CONSIDERED

1. X-ray, chest
2. Ultrasound
    - Transthoracic echocardiography (TTE)
    - Transesophageal echocardiography (TEE)
    - Peripheral venous
3. Nuclear medicine (NUC)
    - Radionuclide myocardial perfusion scan, stress
    - Radionuclide ventriculogram (RNV)
    - Radionuclide ventilation/perfusion (VQ) scan
4. Invasive (INV)
    - Coronary angiography
    - Left ventriculography, heart
    - Angiography, lung
5. Computed tomography (CT)
    - Chest
    - Heart, electrocardiogram (ECG)-gated
6. Magnetic resonance imaging (MRI), heart

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique

to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Shortness of Breath--Suspected Cardiac Origin

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest	9	For evaluation of pulmonary vascularity

Radiologic Exam Procedure	Appropriateness Rating	Comments
		and edema
US, heart, transthoracic (TTE)	8	
NUC, heart, radionuclide myocardial perfusion scan, stress	7	
NUC, heart, radionuclide ventriculogram (RNV)	6	
INV, heart, coronary angiography	6	
INV, heart, ventriculography, left	6	
US, heart, transesophageal (TEE)	5	
CT, chest	5	For evaluation of pulmonary vascularity and edema
CT, heart, ECG-gated	5	Multidetector with maximal temporal and spatial resolution. For detection of coronary artery disease.
MRI, heart	4	
US, peripheral venous	3	Only if DVT or PE suspected
NUC, lung, radionuclide VQ scan	3	Only if PE suspected
INV, lung, angiography	2	Only if PE suspected
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Shortness of breath, or dyspnea, has no precise definition, and patients vary in their attempts to describe the sensation. It may have a respiratory or cardiac origin and may be associated with deconditioning, anemia, or anxiety. Some patients have a combination of these factors that produce dyspnea at rest, after

exercise, or in certain positions (orthopnea, trepopnea, or platypnea, i.e., recumbent, on one side, or in the upright position). Dyspnea may have an acute onset or may be chronic and is more common in the elderly. Breathlessness has been described as "...difficult, labored, uncomfortable breathing."

It is not always easy to distinguish between the various causes of dyspnea, although history, physical examination, and simple laboratory tests usually provide a working diagnosis. The electrocardiogram, plain chest radiograph, and complete blood count are part of the initial diagnostic workup. Simple pulmonary function testing and oximetry are important tests when chronic obstructive pulmonary disease (COPD) or asthma is suspected. Cardiopulmonary exercise testing, with measurement of peak oxygen uptake, is useful in this assessment when combinations of cardiac and respiratory causes are being considered.

Congestive heart failure (CHF) is the most common cardiac cause of dyspnea. CHF may involve both systolic and diastolic left ventricular dysfunction. Although we commonly think of systolic dysfunction as most important because it produces decreased cardiac output, it is the diastolic dysfunction that appears to be associated with the symptom of dyspnea and with reduced functional capacity under the New York Heart Association (NYHA) grading system in some cases. Some patients may have CHF and dyspnea with normal ejection fractions and can be classified as having diastolic heart failure. Ischemic heart disease is the most common cause of CHF, but other etiologies include valvular heart disease, left-to-right shunts, hypertension and hypertrophic myopathies, infiltrative disorders such as amyloid disease, right ventricular failure or overload with abnormal septal intrusion on the left ventricle, pericardial disease with restriction in diastolic filling of the left ventricle (LV) and cardiomyopathies due to alcohol, drugs, radiation, inflammation, peripartum, or unknown causes (idiopathic).

Imaging studies are invaluable for establishing the diagnosis and, in many instances, determining the appropriate management strategy. The plain chest film and echocardiography are the major imaging tools employed, but radionuclide imaging plays an important role. CT and MRI have much to offer but have not been used with much frequency to date. Cardiac angiography and coronary arteriography are invasive imaging techniques that are used extensively for diagnosing or excluding ischemic disease and, together with cardiac hemodynamics and endomyocardial biopsy, are important for precise evaluation of cardiac function and etiology of cardiomyopathies.

Radiograph

The radiograph provides important information about the underlying etiology of dyspnea at a very moderate cost. Most of the noncardiac causes related to primary respiratory conditions can be identified. Cardiomegaly is seen in about half of patients with chronic CHF, and specific chamber enlargement is helpful in detecting valvular heart disease. CHF is fairly reliably manifested in the acute situation by alveolar pulmonary edema or in the chronic situation by interstitial edema. Elevation of left ventricle end-diastolic pressure (LVEDP), however, is not always accompanied by signs of interstitial edema, particularly in patients who have undergone treatment with diuretics and angiotensin-converting enzyme (ACE) inhibitors, whereas clinical symptoms and NYHA grade tend to parallel the radiographic findings of elevated pulmonary capillary wedge pressure (PCWP).

Absence of the radiographic signs of congestion does not ensure a normal LVEDP or PCWP in patients with chronic CHF. Flow to the upper and lower zones of the lung can be determined in both upright and supine radiographs by comparing the ratio of a pulmonary artery to its accompanying bronchus. The pulmonary artery enlarges relative to the bronchus when flow is increased. Normally the flow to the lower lobes exceeds that to the upper lobes with a ratio of less than one in the upper zones and greater than one in the lower zones. Flow to both the upper and lower zones increases with pulmonary plethora, as occurs in renal failure or left-to-right shunts, whereas in impending CHF, upper-zone flow is increased and lower-zone flow is decreased. This results in what is commonly referred to as "pulmonary vascular redistribution."

Echocardiography

Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) are widely available techniques that play an extremely important role in evaluating patients with dyspnea of suspected cardiac origin. LV size, systolic and diastolic function (contraction and relaxation), wall thickness and texture, and the presence of valve dysfunction are obtained with a combination of two-dimensional and color Doppler techniques. Serial studies are easily performed without radiation exposure. TTE has limitations in imaging certain body types, while TEE is somewhat invasive and should be reserved for cases that require better definition of the mitral valve or when TTE is unsatisfactory. Stress echo studies are useful to detect regional wall motion abnormalities in ischemic situations. Abnormalities of diastolic function can be detected in patients with normal heart size. Pericardial restraint during relaxation can often be inferred. Pericardial effusion is easily detected, but pericardial thickening and calcification are not readily seen.

Radionuclide Imaging

Equilibrium-gated blood-pool imaging of the left ventricle in systole and diastole provides reliable and reproducible measurements of ejection fraction and regional wall motion abnormalities and is useful in assessing diastolic and systolic performance. In patients undergoing radionuclide imaging for dyspnea of suspected cardiac origin, dyspnea appears to be an independent predictor of an increased risk for death from cardiac causes and from any cause. It is less dependent than echocardiography on assumptions of ventricular geometry. These studies are widely available and are relatively expensive. They require exposure to radiation, have poor spatial resolution, and may be hampered by cardiac dysrhythmias. Studies can be performed after stress and at rest to assess ventricular function under conditions designed to provoke ischemia. Myocardial perfusion imaging with a variety of agents can be performed at rest and after stress with exercise, dobutamine, dipyridamole, or adenosine. These studies give generally reliable results that detect areas of ischemia, infarction, and hibernating myocardium. They may be useful in patients with dyspnea and suspected myocardial ischemia for demonstrating regional perfusion abnormalities.

Computed Tomography

Conventional CT with contrast infusion gives limited information about cardiac chamber enlargement. It can detect pericardial calcification and effusions and is quite useful for detecting pulmonary causes of dyspnea. Compared to

conventional radiography, CT enables superior assessment of pulmonary vascularity in the context of congestive heart failure. It has little utility in evaluating cardiac function. Gated studies can be performed with multidetector row CT, which provides detailed information on cardiac and general thoracic pathology. Effusions and cardiac tumors are easily detected. Coronary calcium is visible, and several scoring systems have been developed that correlate loosely with severity of coronary artery disease. In addition, such studies can be viewed as multiple frames over a cardiac cycle or in a cine format. Precise and reproducible measurements of ventricular volumes, wall thickness, and regional contraction abnormalities can be made, although multidetector row CT should not be used primarily for evaluating cardiac function. ECG-synchronized CT is also emerging as an important tool for the non-invasive detection of coronary artery stenosis. While currently there is no literature to support the use of CT for the detection of coronary artery disease in the setting of shortness of breath with suspected cardiac origin, it is anticipated that CT of the heart will prove beneficial in the management of patients with this presentation. As with all imaging tests involving use of iodinated contrast material, the diagnostic benefit needs to be weighed against the risk of inducing or worsening congestive heart failure due to contrast related volume overload.

Magnetic Resonance Imaging

To achieve adequate MRI of the heart, artifacts from cardiac and respiratory motion and the flow of blood within vessels need to be corrected. ECG and respiratory gating are required if images are to be acquired over several heartbeats. Current techniques suggest the feasibility of producing satisfactory image quality during a single breathhold or even during a single heartbeat. Cine MRI reveals anatomic and functional abnormalities of the valves, pericardium, and myocardium without the need for radiation or contrast administration.

Currently there are few proven indications for MRI in the setting of acute dyspnea. Research into applying MRI to functional studies of myocardial contraction and diastolic relaxation have shown promise to accurately characterize the functional abnormality and to provide specific tissue characterization of certain infiltrative cardiomyopathies. Until these techniques are studied in more detail and become available to the general public, MRI's clinical applicability remains unproven.

Invasive Techniques

Physiological studies with hemodynamic monitoring of right heart and pulmonary wedge pressures are often useful in detecting a cardiac cause of dyspnea when the etiology is obscure. Angiography may play a role in detecting normal coronary arteries in patients with heart failure due to cardiomyopathy or in revealing coronary disease when the clinical suspicion is low. Left ventricular function is more easily determined noninvasively, but left ventriculography may reveal regional wall motion abnormalities not detected by echocardiography or radionuclide angiography.

Summary

Dyspnea is a poorly understood symptom that may have pulmonary, cardiac, or psychological causes. The simple chest radiograph is most useful in separating

cardiac from pulmonary disease, and the echocardiogram has emerged as the noninvasive modality of choice for determining left ventricular function. Radiographs and echocardiographs are widely available, have virtually no risk, and are suitable for serial studies. Nuclear imaging is widely used as a method for study of left ventricular function as well as myocardial perfusion. Multidetector row CT and cardiac MRI have a variety of limitations, and their efficacy has not been validated on sufficiently large populations, even though they have potential for evaluating anatomy and function.

Abbreviations

- CT, computed tomography
- DVT, deep vein thrombosis
- ECG, electrocardiogram
- INV, invasive
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- PE, pulmonary embolism
- US, ultrasound
- VQ, ventilation/perfusion

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate initial radiologic imaging procedures to aid in differential diagnosis of patients with shortness of breath, suspected cardiac origin

POTENTIAL HARMS

As with all imaging tests involving use of iodinated contrast material, the diagnostic benefit of conventional computed tomography (CT) with contrast infusion needs to be weighed against the risk of inducing or worsening congestive heart failure due to contrast related volume overload.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Schoepf UJ, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Stanford W, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Shortness of breath -- suspected cardiac origin. [online

publication]. Reston (VA): American College of Radiology (ACR); 2006. 5 p. [34 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1995 (revised 2006)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Cardiovascular Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: U. Joseph Schoepf, MD; E. Kent Yucel, MD; Michael A. Bettmann, MD; Thomas Casciani, MD; Antoinette S. Gomes, MD; Julius H. Grollman, MD; Stephen R. Holtzman, MD; Joseph F. Polak, MD, MPH; David Sacks, MD; William Stanford, MD; Michael Jaff, MD; Gregory L. Moneta, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Boxt LM, Bettmann MA, Gomes AS, Grollman J, Henkin RE, Higgins CB, Kelley MJ, Needleman L, Pagan-Marin H, Polak JF, Stanford W, Wexler L. Shortness of breath--suspected cardiac origin. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):23-7.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® Anytime, Anywhere™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI on August 11, 2006.

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